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NAVFAC **IGS-15212 (FEBRUARY 2003)**

Preparing Activity: LANTNAVFACENGCOM **Based on UFGS-15212**

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

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SECTION 15212

HIGH AND MEDIUM PRESSURE COMPRESSED AIR PIPING
02/03

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NOTE: This guide specification is issued by the Atlantic Division, Naval Facilities Engineering Command for regional use in Italy.

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NOTE: This guide specification covers requirements for non-breathing air compressed air systems inside of buildings with pressures up to 34,470 kPa (gage). Project requirements may require supplemental information added to the paragraphs contained herein.

Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of the technical proponents, including their organization designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 520 (1990) Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units

ASME INTERNATIONAL (ASME)

ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.20	(1993; Errata 1994) Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral-Wound, and Jacketed
ASME/ANSI B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B31.1	(1995) Power Piping
ANSI/ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe
ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 182/A 182M	(1996) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 269	(1996) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 312/A 312M	(1995; Rev. A) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 403/A 403M	(1996) Wrought Austenitic Stainless Steel Piping Fittings
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes
ASTM E 381	(1994) Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

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NOTE: An ISO Standard is published by the International Standard Organization which is a worldwide federation of national standards bodies from 120 countries. ISO standards cover all fields except electric and electronical engineering

standards. ISO's are available in both English and French language.

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ISO 5390 (1997) Compressors - Classification

ITALIAN LAWS AND NORMS (D.M.)(LAW)(CIRC.)

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NOTE: Italian laws and normatives are the legislative regulations and decrees issued by the Italian government in the form of laws, norms, decrees, circulars, and letters. These Laws and Decrees concur together with Norms and Standards in forming the governing directives for construction.

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Law 46	(5/3/1990) Regulations for safety of systems
D.L. 93	(25/2/2000) Accomplishment of EEC Directive 97/23/CE in matter of pressure equipment
D.L. 242	(19/03/1996) Modification and Integration to D.L. 626/94
D.L. 494	(14/8/1996) Implementation of the instruction 92/57/CEE concerning the minimum safety and health requirements to be accomplished in temporary or mobile work site
D.P.R. 547	(27/4/1955) Regulations for work accident prevention
D.L. 626	(19/9/1994)Implementation of EEC directives, 89/391/CEE, 89/655/CEE, 89/656/CEE, 90/269/CEE, 90/270/CEE and 90/679/CEE, concerning improvement of safety and health of workers in the working place

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

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NOTE: A UNI Norm is a technical normative recognized as Italian Law, submitted by a private organization "Ente Nazionale Italiano di Unificazione" for Italy and is available only in the Italian language. It is the National Standard.

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UNI 2223	(1967) Metallic pipe flanges - Templates for drilling circular flanges
UNI 2278	(1967) Metallic pipe flanges - Circular slip-on-welding flanges - Nominal pressure 16
UNI 2528-1	(1974) Wrought copper alloys - Special copper alloys - Chemical composition
UNI 3740-1	(1999) Steel fasteners - Technical specifications - Generalities
UNI 4648	(1961) Multiple thread cutters - Metric thread cutting
UNI 4668	(1961) Pressure and vacuum gages - Cock with 1/2 gas connection and connection for control device
UNI 5311	(1963) Gripping and holding appliances - Straps, clamps, squares and bearings - Summary of standard types
UNI 5634	(1997) Identification systems for pipelines and canalizations conveying fluids
UNI 6609	(1969)Metallic pipe flanges - Bolts - Types, materials and ratings
UNI 6884	(1987) Shutting and regulation valves for fluids - Supply and test conditions
UNI 7145	(1972) Pipe clamps for use on board ships - Summary of standard types
UNI 8863/FA-1	(1987/89) Unalloyed steel seamless and welded tubes suitable for screwing in accordance with UNI ISO 7/1
UNI 9335	(1991) Safety valves - General requirements
UNI 9647	(1990) Filters

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN) (UNI EN ISO)(UNI ISO)

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NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English

language and the UNI available only in the Italian language.

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UNI ISO 7-1	(1984) Pipe threads where pressure-tight joints are made on the threads - Part 1: Dimensions, tolerances and designation
UNI EN 837-1	(1998) Pressure gauges - Bourdon tube pressure gauges - Dimensions, metrology, requirements and testing
UNI EN 837-2	(1998) Pressure gauges - Selection and installation recommendations for pressure gauges
UNI EN 837-3	(1998) Pressure gauges - Diaphragm and capsule pressure gauges - Dimensions, metrology, requirements and testing
UNI EN 1074-3	(2001) Valves for water supply - Fitness for purpose requirements and appropriate verification tests - Part 3: Check valves
UNI EN ISO 1127	(1998) Stainless steel tubes - Dimensions, tolerances and conventional masses per unit length
UNI EN 1254-1	(2000) Copper and copper alloys - Plumbing fittings - Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes
UNI EN 1254-2	(2000) Copper and copper alloys - Plumbing fittings - Part 2: Fittings with compression ends for use with copper tubes
UNI EN 1254-3	(2000) Copper and copper alloys - Plumbing fittings - Part 3: Fittings with compression ends for use with plastic pipes
UNI EN 1254-5	(2000) Copper and copper alloys - Plumbing fittings - Part 5: Fittings with short ends for capillary brazing to copper tubes
UNI EN 1567	(2002) Building valves - Water pressure reducing valves and combination water pressure reducing valves - Requirements and tests
UNI ISO 3601-1	(1992) Fluid systems. Sealing devices. O-Rings. Inside diameters, cross- sections, tolerances and size identification code.

UNI EN ISO 8504-2	(2001) Preparation of steel substrates before application of paints and related products - Surface preparation methods - Abrasive blast-cleaning
UNI EN 10216-1	(2002) Seamless steel tubes for pressure purposes - Technical delivery conditions - Non-alloy steel tubes with specified room temperature properties
UNI EN 10216-2	(2002) Seamless steel tubes for pressure purposes - Technical delivery conditions - Non-alloy and alloy steel tubes with specified elevated temperature properties
UNI EN 10242	(2001) Threaded pipe fitting in malleable cast iron
UNI EN 10253-1	(2002) Butt-welding pipe fittings - Part 1: Wrought carbon steel for general use and without specific inspection requirements
UNI EN 12449	(2001) Copper and copper alloys - Seamless, round tubes for general purposes
UNI EN ISO 13920	(2000) Welding - General tolerances for welded constructions - Dimensions for lengths and angles - Shape and position
UNI EN 26704	(1992) Automatic steam traps - Classification
CEI EN 50298	(1999) Empty enclosures for low-voltage switchgear and controlgear assemblies - General requirements
CEI EN 60034-1	(2000) Rotating electrical machines - Part 1: Rating and performance
CEI EN 60947-4-1	(2002) Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA SRM	(1998) Seismic Restraint Manual Guidelines for Mechanical Systems

1.2 RELATED REQUIREMENTS

Section 15050 "Basic Mechanical Materials and Methods," applies to this

section, with the additions and modifications specified herein.

1.3 SUBMITTALS

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NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significant to merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.
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Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

High pressure compressed air system

SD-03 Product Data

Air compressor

Air dryer

Instrumentation and controls

Air receivers [and] [separators]

Desiccant air dryers

Piping and tubing

Fittings

Valves

Adapters

Pressure gages

Snubbers

Timed solenoid drain

Traps

Filters

Strainers

Unions

O-ring gaskets

Flexible connections

Hangers and supports

Valve box

Identification labels for piping

For receivers [and separators] include Manufacturer's Data Report Form U-1 or U-1A.

SD-06 Test Reports

Air compressor

Laboratory test reports for materials used in high pressure systems

NDE report for welding of piping; G

Leak tightness test; G

SD-07 Certificates

Employer's record documents; G

Welding procedures and qualifications; G

SD-08 Manufacturer's Instructions

Air receivers [and] [separators]

Include recommended certification test procedure and procedure for cleaning, external painting, and delivery preparation.

SD-10 Operation and Maintenance Data

Air compressor, Data Package 4

Air dryer, Data Package 4

SD-11 Closeout Submittals

Posted operating instructions for air compressor

Posted operating instructions for air dryer

Posted operating instructions for compressed air system

1.4 QUALITY ASSURANCE

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NOTE: The SMACNA SRM (seismic restraint manual) referenced in the paragraph below shall be applied to locations subject to significant risk of seismic induced loads. The degree to which this manual is to be used for contract drawings and specifications shall be determined by the designer of record in coordination with the NAVFAC Engineering Field Division's Mechanical Design Branch.

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Provide all work specified in this section, including design, materials, fabrication, assembly, erection, installation, and examination, inspection and testing of compressed air system in conformance with Law 46, ASME B31.1, D.L. 93, and SMACNA SRM, as modified and supplemented by this specification section and accompanying drawings. In ASME B31.1, the advisory provisions shall be considered mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" and "owner" shall be interpreted to mean the Contracting Officer.

1.4.1 Equipment Data

Submit the following data for equipment listed for "Operation and Maintenance Instructions, Parts and Testing."

a. Name and address of authorized branch or service department.

b. Characteristic curves.

c. Following applicable data completely filled in:

Manufacturer and model number [_____]

Operating speed [_____]

Capacity [_____] (CMS)

Type of bearings in unit [_____]

Type of lubrication [_____]

Type and adjustment of drive [_____]

Capacity of tank [_____]

Electric motor: Manufacturer, frame and type [_____]

Motor speed [_____] rad/sec

Current characteristics and kW of motor [_____]

[_____] Thermal cut-out switch: Manufacturer, type and model [_____]

Starter: Manufacturer: Type and model [_____]

1.4.2 High Pressure Compressed Air System

Show location, length, and type of welds or brazes, and indicate welding and brazing procedures to be used, preheat, postweld heat treatment, and nondestructive welding and brazing testing required.

1.4.3 Laboratory Test Reports and Material Control

Laboratory Test Reports and Material Control for high Pressure Compressed Air Systems:

1.4.3.1 Laboratory Test Reports

Furnish the following laboratory test reports for pipe, tube, fittings, valves, and other pressure containing components (except pressure gages) for each heat and lot of material.

a. Full chemical analyses.

b. Physical properties.

c. Etch test per UNI EN 10216-2 and ASTM E 381 as modified for the alloy to verify pipe and tube are seamless and free of defects.

1.4.3.2 Material Control

Where more than one type of corrosion resistant alloy (stainless steel and copper-nickel or nickel-copper for example) is to be installed at project site, the Contractor shall implement and maintain a material control system with markings and/or tags to identify positively each piece as to the type of metal.

1.4.4 Welding Requirements

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NOTE: The drawings should be checked to ensure that any supplementary information required by the welding and NDE paragraphs has been shown and that there is not conflict between the project drawings and the specifications.

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NOTE: Drawings must indicate, or test of the project specifications must specify, the tensile strength, elongation, shear strength, size, length, type, and location of the welds, as necessary.

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Provide all welding work specified in this section for compressed air piping systems in conformance with ASME B31.1, as modified and supplemented

by this specification section and accompanying drawings. The welding work includes, but is not limited to, qualification of welding procedures, brazing procedures, welders, brazers, welding operators, brazing operators, inspection personnel, and nondestructive examination personnel; maintenance of welding records, and examination methods for welds.

1.4.4.1 Butt Welded Joints

Butt welded joints shall be full penetration joints. Butt welded joints in systems with working pressures over 2068 kPa (gage) shall be full penetration welds with consumable inserts or backing rings.

1.4.5 Employer's Record Documents

Submit to the Contracting Officer for his review and approval the following documentation. This documentation and the subject qualification shall be in compliance with ASME B31.1.

a. List of qualified welding procedures that is proposed to be used to provide the work specified in this specification section.

b. List of qualified welders, brazers, welding operators, and brazing operators that are proposed to be used to provide the work specified in this specification section.

c. List of qualified weld inspection personnel that are proposed to be used to provide the work specified in this specification section.

1.4.6 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding procedure specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds.

b. Certification: Before assigning welders or welding operators to the work, submit a list of qualified welders, together with data and certification that each individual is performance qualified as specified. Do not start welding work prior to submitting welder and welding operator qualifications. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

1.4.7 Experience for Installation and Testing

Experience for Installation and Testing Of [Medium] [and] [High] Pressure Air System: Install and test [medium] [and] [high] pressure air piping and equipment in accordance with ASME B31.1 and only with competent personnel specially trained and experienced in installation and testing of [medium] [and] [high] pressure air systems. The supervisors and personnel

performing installation and testing shall have had previous experience in the satisfactory installation and testing of at least two [medium] [and] [high] pressure air systems. Submit data substantiating this experience to the Contracting Officer for approval prior to performing any work. Supervisors and personnel with experience not acceptable to the Contracting Officer will be prohibited from working on these systems. Experience data shall include the following.

a. Name of employee

b. Employer

c. List educational background and specialized training on installation and testing [medium] [and] [high] pressure systems, including safety precautions.

d. List at least two installations of each type of system worked on and installed and tested satisfactorily.

(1) Type of system and operating or design pressure; for medium pressure 869 to 2751 kPa (gage); for high pressure 2758 kPa (gage) and higher.

(2) Company or owner.

(3) Location.

(4) Name, address, and phone number of a person who can be contacted for verification at the installation.

e. If registered engineer, give the state in which registration is held, and branch of engineering. An engineer is required to supervise safety during testing of medium and high pressure air systems.

1.4.8 Training

Where special cleaning, flushing, material control, testing, and other special requirements are used on a contract, such as required for high pressure compressed air systems, conduct formal training programs for employees on the special requirements. Maintain records on such training which shall be available for inspection by the Contracting Officer. Certify that employees have satisfactorily completed the required training prior to performing work on the contract.

1.5 SAFETY PRECAUTIONS

1.5.1 Temperature Restriction

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NOTE: The designer shall assure that the piping design temperature is not exceeded, especially for high pressure systems. Provide aftercoolers and high temperature shutdown devices as required for

safe operation of the systems.
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Compressors or other equipment shall not discharge compressed air to the piping systems above [38] [_____] degrees C unless approved by the Contracting Officer. Aftercoolers or other devices shall be provided to comply with the temperature restriction.

1.5.2 Rotating Equipment

Fully guard couplings, motor shafts, gears and other exposed rotating or rapidly moving parts in accordance with D.P.R. 547, D.L. 626, and D.L. 242. Provide rigid and suitably secured guard parts readily removable without disassembling guarded unit.

1.5.3 Welding and Brazing

Safety in welding, cutting, and brazing of pipe shall conform to D.P.R. 547, D.L. 626, D.L. 242, and D.L. 494.

PART 2 PRODUCTS

2.1 SOURCE MANUFACTURERS

2.1.1 Air Compressors

The following manufacturers provide medium and high pressure air compressor units that generally comply with these specifications:

AMP Peluffo
Via Piemonte, 12/A
17024 Finale Ligure (SV)
Tel: 019-602496
Fax; 019-6049807
www.apmpeluffo.com

ATLAS COPCO ITALIA S.p.A.
Via Fratelli Gracchi, 39
20092 Cinisello Balsamo (MI)
Tel: 02-617991
Fax: 02-6171949
www.atlascopco.it

BAUER COMPRESSORI srl
viale dell'Industria, 12/G
36100 Vicenza
Tel: 0444-961555
Fax: 0444-965373
e-mail: info@bauer-compressori.com

COMPAIR ITALIA S.r.l.
Via Archimede, 31
20041 Agrate Brianza (MI)
Tel: 039-65511

Fax: 039-6056458
www.compair.it

INGERSOLL-RAND ITALIANA S.p.A.
Strada Cassanese
20060 Vignate
Tel: 02-950-561
Fax: 02-953-60159

WORTHINGTON S.p.A.
Flowserve Corporation
Via Rossini, 90/92
20033 Desio - Milano
Tel: 0362-6121
Fax: 0362-303396
www.flowserve.com

2.1.2 Compressed Air Dryers

The following manufacturers provide medium and high pressure compressed air dryers that generally comply with these specifications:

BAUER COMPRESSORI srl
viale dell'Industria, 12/G
36100 Vicenza
Tel: 0444-961555
Fax: 0444-965373
e-mail: info@bauer-compressori.com

FRIULAIR DRYERS
Via Cisis, 36 S.S. 352 km 21
33050 Cervignano del Friuli (UD)
Fraz. Strassoldo
Tel: 0431-939416
Fax: 0431-939419
www.friulair.com

PNEUMOFORE S.p.A.
Via N. Bruno, 34
10090 Rivoli (TO)
Tel: 011-950-4030
Fax: 011-950-4040
www.pneumofore.com

HIROSS S.p.A.
via Leonardo da Vincci, 8
35028 Piove di Sacco (PD)
Tel: 049-9719212
Fax: 049-9719317
www.hiross.com

WORTHINGTON S.p.A.
Flowserve Corporation
Via Rossini, 90/92

20033 Desio - Milano
Tel: 0362-6121
Fax: 0362-303396
www.flowserve.com

2.1.3 Air Receivers

The following manufacturers provide medium and high pressure air receiver and separator units that generally comply with these specifications:

BINDA ALDO
Viale Martiri della Liberta, 43
Voghera
Tel: 0383-47817
Fax: 0383-366965
www.airbinda.com

PNEUMOFORE S.p.A.
Via N. Bruno, 34
10090 Rivoli (TO)
Tel: 011-950-4030
Fax: 011-950-4040
www.pneumofore.com

HIROSS S.p.A.
via Leonardo da Vincci, 8
35028 Piove di Sacco (PD)
Tel: 049-9719212
Fax: 049-9719317
www.hiross.com

AIRTEC
Via B. Bozzi, 8
42025 Cavriago (RE)
Tel: 0522-941125
Fax: 0522-941307

2.1.4 Chilled Water Type Compressed Air Dryers

The following manufacturers provide chilled water type compressed air dryers that generally comply with these specifications:

ATLAS COPCO ITALIA S.p.A.
Via Fratelli Gracchi, 39
20092 Cinisello Balsamo (MI)
Tel: 02-617991
Fax: 02-6171949
www.atlascopco.it

FRIULAIR DRYERS
Via Cisis, 36 S.S. 352 km 21
33050 Cervignano del Friuli (UD)
Fraz. Strassoldo
Tel: 0431-939416

Fax: 0431-939419
www.friulair.com

HIROSS S.p.A.
via Leonardo da Vincci, 8
35028 Piove di Sacco (PD)
Tel: 049-9719212
Fax: 049-9719317
www.hiross.com

WORTHINGTON S.p.A.
Flowserve Corporation
Via Rossini, 90/92
20033 Desio - Milano
Tel: 0362-6121
Fax: 0362-303396
www.flowserve.com

2.1.5 Desiccant Air Dryers

The following manufacturers provide desiccant air dryer units that generally comply with these specifications:

ATLAS COPCO ITALIA S.p.A.
Via Fratelli Gracchi, 39
20092 Cinisello Balsamo (MI)
Tel: 02-617991
Fax: 026171949
www.atlascopco.it

IMSYSTEM
Via Palermo, 6
09023 Monastir (CA)
Tel: 070-9177558
Fax: 178-2207119
www.imsystem.com

HIROSS S.p.A.
via Leonardo da Vincci, 8
35028 Piove di Sacco (PD)
Tel: 049-9719212
Fax: 049-9719317
www.hiross.com

WORTHINGTON S.p.A.
Flowserve Corporation
Via Rossini, 90/92
20033 Desio - Milano
Tel: 0362-6121
Fax: 0362-303396
www.flowserve.com

2.1.6 Piping and Tubing

The following manufacturers provide medium and high pressure system air piping and air tubing that generally comply with these specifications:

A.D. TUBI INOSSIDABILI
Via per Cavolto, 11
22040 Anzano del Parco (CO)
Tel: 031/630672
Fax: 031/630810
www.adtubi.it

STEELTRADE
Loc. Cattagnina
29100 Rottofreno (PC)
Tel: 0523/780121
Fax: 0523/780123
www.steeltradeitaly.com

ISO CLIMA srl
Via Giovanni XXIII, 58
25086 Rezzato (BS)
Tel: 030/2590700
Fax: 030/2590719
www.isoclima.com

FRA.BO S.p.A.
Via Circonvallazione, 7
26020 Bordolano (CR)
Tel: 0372/925188
Fax: 0372/95886
www.frabo.net

CR srl
Via Pergola, 58 25080 Moniga del Garda
Tel: 0365/502073
Fax: 0365/502672
www.cr-srl.com

DALMINE
Piazza Caduti 6 Luglio 1944, 1
24044 Dalmine (BG)
Tel: 035560-1111
Fax: 035560-3827
www.dalmine.it

JANNONE ARM S.p.A.
Via Nuova Villa, 29
80100 Napoli
Tel: 081-7523788
Fax: 081-7523425
www.jannonearm.com

JANNONE TUBI s.r.l.
via Biagio Accolti Gil - zona industriale
Bari

Tel: 080-5311448
Fax: 080-5312976
www.jannonearm.com

2.1.7 Globe and Angle Valves

The following manufacturers provide globe and angle type valves for compressed air systems that generally comply with these specifications:

MARIANI RUBINETTERIE INDUSTRIALI srl
Via per Valduggia, 12
13011 Borgosesia (VC)
Tel: 0163-23368
Fax: 0163-27900
www.marianirubinetterie.it

EURA srl
Via Bissolati, 6
20125 Milano
Tel: 02-60781714
Fax: 02-6887635
e-mail: eura.valves@tiscalinet.it

KSB ITALIA S.p.A.
Viale Tunisia, 46
20214 Milano
Tel: 02-6274-3273
Fax: 02-6698-3272

CAZZANIGA S.p.A.
Via Parco
20046 Biassono - Milano
Tel: 039-49861
Fax: 039-4986222

2.1.8 Check Valves

The following manufacturers provide check valves for compressed air systems that generally comply with these specifications:

MARIANI RUBINETTERIE INDUSTRIALI srl
Via per Valduggia, 12
13011 Borgosesia (VC)
Tel: 0163-23368
Fax: 0163-27900
www.marianirubinetterie.it

VILLA VALVOLE
via Scappini, 11
16149 Genova
Tel: 01064-44949
Fax: 01064-50996

RASTELLI RUBINETTERIE S.p.A.

Regione Monticelli 10/14
28045 Invorio (NO)
Tel: 0322-255431
Fax: 0322-255117
www.rastelli.it

2.1.9 Pressure Reducing Valves

The following manufacturers provide pressure reduction type valves for compressed air systems that generally comply with these specifications:

HYDRAFORCE HYDRAULICS, Ltd.
Via Enrico da Porto, 10C
37023 Grezzana (Verona)
Tel: 045-8650696
Fax: 045-8669602

RUBINETTERIE STELLA
Via Unita' d'Italia, 1
28100 Novara
Tel: 0321/473351
Fax: 0321/474231
www.rubinetteriestella.it

MCR Srl
Via E. Brigatti, 52/C
22050 Ronco Briantino (MI)
Tel: 039-6815-152
Fax: 039-6815-148

FAR RUBINETTERIE S.p.A.
Via Morena, 20
28024 Gozzano (NO)
Tel: 0322-94722
Fax: 0322-955332
www.far-spa.it

CAZZANIGA S.p.A.
Via Parco
20046 Biassono - Milano
Tel: 039-49861
Fax: 039-4986222

2.1.10 Safety Valves

The following manufacturers provide safety type valves for compressed air systems that generally comply with these specifications:

A.S.T. S.p.A.
Via R. Merendi, 20
20010 Cornaredo (MI)
Tel: 0293-560606
Fax: 0923-62248
www.astspa.it

TYCO Valves & Controls
Distribution Italy
29018 Lugagnano Val d'Arda (PC)
Tel: 0523-890201
Fax: 0523-890290

FINI COMPRESSORS S.p.A.
Via F.lli Vignoli, 3
40069 Zola Predona - Bologna
Tel: 051-6168111
Fax: 051-752408

2.1.11 Needle Valves

The following manufacturers provide needle valves for compressed air systems that generally comply with these specifications:

MARIANI RUBINETTERIE INDUSTRIALI srl
Via per Valduggia, 12
13011 Borgosesia (VC)
Tel: 0163-23368
Fax: 0163-27900
www.marianirubinetterie.it

SBC srl
Via Tolstoi, 86
20098 San Giuliano (MI)
Tel: 02-98491676
Fax: 02-98491712
www.sbc-it.com

CAZZANIGA S.p.A.
Via Parco
20046 Biassono - Milano
Tel: 039-49861
Fax: 039-4986222

FINI COMPRESSORS S.p.A.
Via F.lli Vignoli, 3
40069 Zola Predona - Bologna
Tel: 051-6168111
Fax: 051-752408

2.1.12 High Pressure Gages

The following manufacturers provide pressure gages for high pressure compressed air systems that generally comply with these specifications:

WIKA Italiana S.r.l.
Via Achille Grandi, 4
20017 Mazzo di Rho (MI)
Tel: 02-9397001
www.wika.it

NUOVA FIMA
Via Cesare Battisti, 59
28045 Invorio (NO)
Tel: 0322-253200
Fax: 0322-253232

2.1.13 Medium Pressure Gages

The following manufacturers provide pressure gages for medium pressure compressed air systems that generally comply with these specifications:

SWAGELOK-NORDIVAL Srl
Via Iseo, 6/A
25030 Erbusco (BS)
Tel: 030-7722055
Fax: 030-7722024
www.swagelok.com

NUOVA FIMA
Via Cesare Battisti, 59
28045 Invorio (NO)
Tel: 0322-253200
Fax: 0322-253232
www.nuovafima.com

2.1.14 Snubbers

The following manufacturers provide snubbers (or equalizers) for high pressure compressed air systems that generally comply with these specifications:

FLUID PRESS S.p.A.
Via A. Varisco, 2
42020 Albinea (RE)
Tel: 0522-347034
Fax: 0522-347033
www.fluidpress.it

SWAGELOK-NORDIVAL Srl
Via Iseo, 6/A
25030 Erbusco (BS)
Tel: 030-7722055
Fax: 030-7722024
www.swagelok.com

2.1.15 Solenoid Drain

The following manufacturers provide timed solenoid drains for compressed air systems that generally comply with these specifications:

HYDRA FORCE HYDRAULICS, LTD
Via enrico da Porto, 10 c
37023 Grezzana (VR)

Tel: 045/8650696
Fax: 045/8669602
www.hydraforce.co.uk

FANTINI COSMI
Via dell'Osio, 20090 Settala (MI)
Tel: 02/9589329
Fax: 02/95307184
www.fantinicosmi.com

DANFOSS
Via Imola, 9
40128 Bologna
Tel: 051-322139
Fax: 051-320165
www.danfoss.it

2.1.16 Air Filters

The following manufacturers provide compressed air filters for compressed air systems that generally comply with these specifications:

ATLAS COPCO ITALIA S.p.A.
Via Fratelli Gracchi, 39
20092 Cinisello Balsamo (MI)
Tel: 02-617991
Fax: 026171949
www.atlascopco.it

SOTRAS
Via Donatello, 13
10071 Borgaro Torinese (TO)
Tel: 011/2622222
Fax: 011/2624141
www.sotras.com

SWAGELOK-NORDIVAL Srl
Via Iseo, 6/A
25030 Erbusco (BS)
Tel: 030-7722055
Fax: 030-7722024
www.swagelok.com

FINI COMPRESSORS S.p.A.
Via F.lli Vignoli, 3
40069 Zola Predona - Bologna
Tel: 051-6168111
Fax: 051-752408

JUCKER S.p.A.
via G. Verdi, 9
23871 Lomagna (LC)
Tel: 039-59181
Fax: 039-5301286

www.jucker.it

2.1.17 Strainers

The following manufacturers provide line strainers for compressed air systems that generally comply with these specifications:

MARIANI RUBINETTERIE INDUSTRIALI srl
Via per Valduggia, 12
13011 Borgosesia (VC)
Tel: 0163/23368
Fax: 0163/27900
www.marianirubinetterie.it

EURA srl
Via Bissolati, 6
20125 Milano
Tel: 02-60781714
Fax: 02-6887635
e-mail: eura.valves@tiscalinet.it

FINI COMPRESSORS S.p.A.
Via F.lli Vignoli, 3
40069 Zola Predona - Bologna
Tel: 051-6168111
Fax: 051-752408

JUCKER S.p.A.
via G. Verdi, 9
23871 Lomagna (LC)
Tel: 039-59181
Fax: 039-5301286
www.jucker.it

2.1.18 Hangers and Supports

The following manufacturers provide hangers and support materials for compressed air systems that generally comply with these specifications:

PROSYSTEM
Via dell'Industria, 2
30031 Arino di Dolo (VE)
Tel: 041/5101622
Fax: 041/5131351
E-mail: info@prosystemitalia. com
www.prosystemitalia.com

GRINNEL SALES & DISTRIBUTION
Via San Giacomo, 260
39055 Laives (BZ)
Tel: 0471/252091
Fax: 0471/254058

SWAGELOK-NORDIVAL Srl

Via Iseo, 6/A
25030 Erbusco (BS)
Tel: 030-7722055
Fax: 030-7722024
www.swagelok.com

2.1.19 Fittings

The following manufacturers provide fittings for medium pressure compressed air systems that generally comply with these specifications:

CARRARA S.p.A.
Via Provinciale, 1/E
25030 Adro (BS)
Tel: 030-745-1121
Fax: 030-745-1130
www.carrara.it

DALMINE
Piazza Caduti 6 Luglio 1944, 1
24044 Dalmine (BG) Italy
Tel: 035/560.111
Fax: 035/560.381
www.dalmine.it

HYDROFLEX
Via Comunale Maranda, 67
Napoli
Tel: 0-815-770315
Fax: 0-815-770756
www.hydroflex.it

RACCORTUBI GROUP
Via Adamello, 1
20010 Arluno (MI)
Tel: 02-9037291
Fax: 02-90376337
www.raccotrubi.it

STEEL TRADE
Loc. Cattagnina
29100 Rottofreno (PC)
Tel: 0523-780121
Fax: 0523-780123
www.steeltradeitaly.com

SWAGELOK-NORDIVAL Srl
Via Iseo, 6/A
25030 Erbusco (BS)
Tel: 030-7722055
Fax: 030-7722024
www.swagelok.com

2.1.20 Flat-Faced Steel Flanges

The following manufacturers provide flat-faced steel flanges for compressed air systems that generally comply with these specifications:

STEEL TRADE
Loc. Cattagnina
29100 Rottofreno (PC)
Tel: 0523/780121
Fax: 0523/780123
www.steeltradeitaly.com

OPPO Gesuino
Via Amerigo Vespucci, 1
09074 Ghilarza (OR)
Tel: 0785/54642
www.oppo.it

2.1.21 Traps

The following manufacturers provide traps for compressed air systems that generally comply with these specifications:

AIRTEC
Via Torquato Tasso, 13
24020 Gorle (BG)
Tel: 035-655988
Fax: 035-669112
www.airtecariacompressa.com

VALSAR Srl
Via Benadir, 14
20132 Milano
Tel: 02-2613-744
Fax: 02-2829-633
www.valsar.it

FINI COMPRESSORS S.p.A.
Via F.lli Vignoli, 3
40069 Zola Predona - Bologna
Tel: 051-6168111
Fax: 051-752408

JUCKER S.p.A.
via G. Verdi, 9
23871 Lomagna (LC)
Tel: 039-59181
Fax: 039-5301286
www.jucker.it

2.1.22 O-Ring Gaskets

The following manufacturers provide o-ring gaskets for compressed air systems that generally comply with these specifications:

AMPLA S.p.A.
Strada per Cascina Restelli, 12
20040 Aicurzio (MI)
Tel: 39-690-1092
Fax: 39-690-2255
e-mail: info@ampla.it

STAMPAGGIO GOMMA
Via Mottarone, 6
21020 Bodio Lomuago (VA)
Tel: 0332/948626
Fax: 0332/947764
www.stampaggiogomma.it

2.1.23 Valve Boxes

The following manufacturers provide valve boxes for compressed air systems that generally comply with these specifications:

ALDO LARCHER
Via Artigiani 5 Handwerkerstrasse
I-39057 Appiano (BZ) Eppan
Tel: 0471-662486
Fax: 0471-661790
www.aldolarcher.com

MARIO CIRINO POMICINO S.p.A.
Strada Provinciale Arzano
80022 Arzano (NA)
Tel: 081-5734740
Fax: 081-5735928-3077-1418
E-mail: mcpomicino@galactica.it

MUSILLI PREFABBRICATI
Via Casilina Sud, 49
03043 Cassino (FR)
Tel: 0776-312431
Fax: 0776-310420

OPPO Gesuino
Via Amerigo Vespucci, 1
09074 Ghilarza (OR)
Tel: 0785-54642
www.oppo.it

2.1.24 Identification Labels

The following manufacturers provide identification labels for compressed air systems that generally comply with these specifications:

PROSYSTEM
Via dell'Industria, 2
30031 Arino di Dolo (VE)
Tel: 041-5101622

Fax: 041-5131351
e-mail: info@prosystemitlia.com
www.prosystemitalia.com

GENERAL FIRE
Via Casilina, 159
00176 Roma
Tel: 06-70301043-9
Fax: 06-70301043
www.generalfire.it

2.1.25 Identification Tape

The following manufacturers provide identification tape for buried utility lines that generally comply with these specifications:

COMBY ITALIA srl
Via Roma, 28
Padenghe sul Garda
25080 Brescia
Tel: 030-9907203
Fax: 030-9900428

SWAGELOK-NORDIVAL Srl
Via Iseo, 6/A
25030 Erbusco (BS)
Tel: 030-7722055
Fax: 030-7722024
www.swagelok.com

OPPO Gesuino
Via Amerigo Vespucci, 1
09074 Ghilarza (OR)
Tel: 0785-54642
www.oppo.it

UNIGASKET
Via Roma, 46
I-24067 Sarnico
Tel: 035-910-328
Fax: 035-911-137

2.2 HIGH PRESSURE AIR COMPRESSOR

****
NOTE: Prepare section for cooling water and include in project specification. See Section 15181 for piping and equipment which may be useful.
****

****
NOTE: Select aftercooler for 38 degrees C discharge or design special piping for higher temperature discharge. Paragraphs entitled "High Pressure Air

Piping for 34,470 kPa (gage) at 38 degrees C System," and "High Pressure Air Piping for 20,682 kPa (gage) at 38 degrees C System" are rated for 38 degrees C.

****

2758 to 34,470 kPa (gage) system, multi-cylinder, multi-stage, [air] [water] cooled, reciprocating, [belt][direct]-driven, base-mounted type, rated for continuous duty at [20,682] [_____] kPa (gage) and capacity indicated. Mount compressor, motor, controls, and instruments on a welded steel base plate. [Provide means to adjust V-belt tension.] Provide splash lubricated compressor not to exceed 105 rad/sec, or pressure lubricated compressor not to exceed 188 rad/sec. Provide three phase squirrel cage induction motor not exceeding 188 rad/sec, with voltage characteristics as indicated, and open drip-proof enclosure. Crankshaft and connecting rods shall be steel. Frame (crankcase), cylinders, and cylinder heads shall be close grain cast iron. Fully enclose frame. Provide automatic unloaders to permit the compressor to start unloaded. Provide [air] [water] cooled coolers after every stage of compression to cool discharge air to within [4] [-7] [_____] degrees C of ambient air temperature. Provide automatic condensate drains to drain condensate during operation and when the compressor stops. Conform to ISO 5390 and CEI EN 60034-1for motor and CEI EN 60947-4-1 and CEI EN 50298 for controls.

2.2.1 Controls

****

NOTE: Select the first paragraph for only start-stop control or the second paragraph and subparagraphs for dual control.

****

[Start-stop control compressors by means of pressure switches [and arrange for a lead compressor and a lag compressor]. [Lead] compressor shall start when the pressure falls to [17,235] [_____] kPa (gage) and stop when the pressure reaches [20,682] [_____] kPa (gage). [Lag compressor shall start when the pressure falls to [13,788] [_____] kPa (gage) and stop when the pressure reaches [20,682] [_____] kPa (gage).] When both compressors stop at cutout pressure, the lead and lag positions of compressors shall be interchanged automatically by means of an electric alternator.]

[Regulate compressor by dual control. Dual system shall consist of a combination of constant speed control and an automatic start-and-stop control by automatic or manual selector switch.]

****

NOTE: Include "Start-and-Stop Control" and "Constant Speed Control" below only for "Dual Control" option.

****

2.2.1.1 Start-and-Stop Control

When set for start-and-stop control, motor shall stop automatically when

discharge pressure reaches maximum pressure setting and start automatically when discharge pressure falls to minimum setting. Cylinders shall unload during periods of motor shutdown.

2.2.1.2 Constant Speed Control

Compressor shall operate continuously at constant speed. Provide means to automatically load and unload compressor at preset minimum and maximum pressure settings, respectively. Provide means for automatic release of pressure within cylinders when the unit is operating without load. Also provide means for manual or automatic unloading of cylinders during starting of unit. Equip compressor with a timed control to stop compressor after a 10-minute unloaded period if air is not used.

2.2.2 Safety Controls

Provide safety controls to shutdown [each] compressor on high discharge air temperature or low oil pressure for pressure lubricated compressor and low oil level for splash lubricated compressor. Set high temperature shutdown at [54] [_____] degrees C. Indicate each shutdown condition by a light on the compressor control panel.

2.2.3 Accessories

Provide pressure gages and relief valves on intercoolers and on the aftercoolers. Provide [totally enclosed belt guards,] discharge check valves, and pressure switches.

2.2.4 Noise

84 dBA maximum sound level one meter from compressor unit.

2.3 HIGH PRESSURE COMPRESSED AIR DRYER

Include component equipment, inter-connecting piping, wiring and controls, mounted in a cabinet and requiring only the connection to utilities. Degrease dryer cabinet, prime coat, and finish coat with baked enamel. Contractor shall furnish integral components whether specifically required by this specification or not. Air shall leave the dryer at a temperature of [_____] degrees C and a dew point of [_____] degrees C, based on an inlet temperature of [38] [_____] degrees C. Pressure drop shall not exceed [21] [_____] kPa. Provide complete internal tubing, wiring, and piping, such that only connections to air inlet and outlet, to refrigerant compressor contactor, and to condensate drain are necessary.

2.3.1 Construction

Heat sink type dryer consisting of a mechanical refrigeration system equipped with an automatic temperature shutdown switch to prevent freezing, a large aluminum granule heat sink to allow a minus 16 degrees C automatic temperature control, regenerative air to air exchanger, and main compressed air cooling exchanger. Refrigeration system shall cool thermal mass heat sink which shall, in turn, lower compressed air temperature to dry air. A direct air to refrigerant gas heat exchanger is not acceptable. Dryer

shall have no internal traps or filters and shall have large internal air passages to minimize pressure drop.

2.3.2 Air Circuit

Include the following:

a. Regenerative heat exchanger: ASTM A 269, Type 304L and UNI EN ISO 1127 seamless stainless steel tube construction, inlet compressed air to outlet compressed air heat exchanger designed to reduce cooling load at design conditions minus 7 degrees C by inlet air precooling.

b. Main heat exchanger: ASTM A 269, Type 304L and UNI EN ISO 1127 seamless stainless steel tube construction, single-pass, designed for minimum air pressure drop with air in the tubes surrounded by aluminum granules.

c. Separator: Fabricated of ASTM A 269, Type 304L and UNI EN ISO 1127 seamless stainless steel in accordance with ASME B31.1. Code stamp is not required. Provide moisture separator, low velocity type, incorporating change of air flow direction to prevent moisture carryover.

d. Dryer operating pressure: [20,682] [34,470] [_____] kPa (gage) working pressure.

e. Drain line: Provide drain line to exterior of dryer with [condensate trap] [or] [automatic drain valve].

f. Exterior piping connections: Provide with square ends.

2.3.3 Refrigeration System

Include the following:

a. Compressor: ISO 5390 and ARI 520. Hermetic reciprocating compressor equipped with automatic start-stop control, inherent motor protection, crankcase oil strainer, and suction screen. Refrigerant shall be R407-C and R134a.

b. Dryer controls: Capable of automatic 0 to 100 percent capacity control with an automatic control expansion valve with sensing bulb to control capacity, with automatic shutdown switch sensor located at point of lowest temperature to prevent freezing.

c. Air cooled condenser.

2.3.4 Instrumentation and Controls

Provide control panel in dryer cabinet containing:

a. Indicators:

(1) Inlet air pressure gage

(2) Discharge air pressure gage

(3) Inlet air temperature gage

(4) Main exchanger temperature gage

(5) Refrigeration compressor suction pressure gage

(6) Refrigeration compressor discharge pressure gage

(7) Power interruption light

(8) High temperature light

(9) Power on light

b. Electrical relays: Locate in an enclosed portion of panel, accessible for easy servicing.

c. Controls and interlocks:

(1) Condenser fan

(2) Compressor across the line contactor

(3) Thermostatic control switch

2.4 HIGH PRESSURE AIR RECEIVERS [AND] [SEPARATORS]

****

NOTE: Do not permit field welding on high pressure air receivers unless controls over welding processes and nondestructive testing required by the military specification can be implemented in the field.

****

D.L. 93, seamless, forged, [20,682] [34,470] kPa (gage) design working pressure, minimum safety factor of 4, corrosion allowance of [1.60] [_____] mm, straight thread, 0-ring sealed, forged steel inlet, outlet, and drain plugs, straight or angle connection as indicated or required. [Capacity] [Capacities] as indicated. After heat treatment, examine exterior of vessel by liquid penetrant or magnetic particle test; no defects are permitted. Furnish certified (nondestructive examination) NDE report for high pressure air receiver. After hydrostatic testing at the factory, clean the flask to oil-free condition. Abrasive blast interior and exterior to near white condition. Vacuum clean surfaces to remove dust and debris. Check surfaces with black light to ensure there is no oil. Apply 2 or 3 coats of epoxy coating 0.20 mm minimum dry film thickness, with white finish coat for the interior and gray finish coat for the exterior. Provide certification of factory tests. Securely support receiver and equip with pressure gage, drain valve, and pressure relief valve set as indicated and piped to discharge in a safe manner. Piping shall conform to

[20,682] [34,470] kPa (gage) standards. Provide each receiver with internal or external blowdown and drain line with manual valve in accessible location, or with extension stem, discharging through a visible open sight drain. Do not manifold cylinder drain piping together. Attachment welds to receiver [and separator] shall not be permitted.

2.5 MEDIUM PRESSURE AIR COMPRESSOR

****

NOTE: Prepare section for cooling water and include in project specification. See Section 15181 for piping and equipment which may be useful.

****

ISO 5390. 869 to 2751 kPa (gage) system. [Multi-stage] [Two-stage] [Single-stage], [air] [water] cooled reciprocating, [belt] [direct] driven type, suitable for supplying compressed air at pressures indicated. Provide compressor with ball or roller type bearing, pressure lubricated, thermal overload protection as required by NEMA, pressure switch, inlet filter-mufflers, vibration isolators, intercoolers, aftercooler, and flexible connectors. Provide safety control for shutdown and alarm on high discharge air temperature or low oil pressure. Capacity and operating pressure as indicated on drawings. Mount compressor and motor on a base plate [and set on the receiver. Design receiver for additional load of compressor and motor].

2.5.1 Receiver

Build receiver (tank) of welded steel, in accordance with D.L. 93 and UNI 9335, for [2751] [_____] kPa (gage) working pressure at [232] [_____] degrees C, complete with pressure gage, safety valve, check valve, shut-off valve on tank outlet, and automatic tank drain on tank. Provide tank with steel supports and bolt to a concrete foundation. Capacity as indicated.

2.5.2 Motor and Starter

Provide motor and starter 40 degrees C ambient temperature rise, continuous duty, drip-proof type motor, ball bearings, for operation with current of voltage, phase, and cycle indicated on the electrical drawings. Motor of such capacity that brake horsepower required by driven equipment at normal rated capacity will not exceed nameplate rating of motor. Provide each motor with automatic, fully enclosed, magnetic starter. Conform to CEI EN 60034-1 for motor and CEI EN 60947-4-1 and CEI EN 50298 for starter and controls.

2.5.3 Controls

****

NOTE: Select the first paragraph for only start-stop control or the second paragraph and subparagraphs for dual control.

****

[Provide start-and-stop control. Motor shall stop automatically when

discharge pressure reaches maximum pressure setting and start automatically when discharge pressure falls to minimum setting. Cylinders shall unload automatically during periods of motor shutdown.]

[Regulate compressor by dual control. Dual system shall consist of a combination of constant speed control and an automatic start-and-stop control by automatic or manual selector switch.]

****

NOTE: Include "Start-and-Stop Control" and "Constant Speed Control" below only for the "Dual Control" option.

****

2.5.3.1 Start-and-Stop Control

When set for start-and-stop control, motor shall stop automatically when discharge pressure reaches maximum pressure setting and start automatically when discharge pressure falls to minimum setting. Cylinders shall unload during periods of motor shutdown.

2.5.3.2 Constant Speed Control

Compressor shall operate continuously at constant speed. Provide means to automatically load and unload compressor at preset minimum and maximum pressure settings, respectively. Provide means for automatic release of pressure within cylinders when the unit is operating without load. Also provide means for manual or automatic unloading of cylinders during starting of unit. [Equip compressor with a timed control to stop compressor after a 10-minute unloaded period if air is not used.]

2.5.4 Intercoolers and Aftercoolers

Provide intercoolers between all intermediate stages of multi-stage compressors and provide aftercoolers with compressors. Intercoolers for air-cooled compressors shall be the tube-and-fin type. Intercoolers for water-cooled compressors shall be the shell-and-tube type, except that tube-and-fin type may be used when the intercooler is supported by the compressor frame or attached to the compressor. Air or water cooled intercoolers may be the integral cast type when compressor is 19 kW or less. Aftercoolers shall be of the water-cooled shell-and-tube type or air-cooled tube-and-fin type. Water-cooled aftercoolers and intercoolers shall be of sufficient capacity to cool the compressed air to within minus 9 degrees C and minus 7 degrees C, respectively, of the temperature of the water entering the coolers. Air-cooled intercoolers and aftercoolers shall have sufficient capacity to cool the compressed air to within minus 7 degrees C of the ambient temperature under the atmospheric conditions indicated. Provide water-cooled intercoolers and aftercoolers with sight-flow indicator to visually observe the flow of water to the cooler. The pressure drop of compressed air through the cooler shall not exceed 7 kPa. Provide intercoolers and aftercoolers with a moisture separator and drain trap to remove the condensed moisture and oil from the air leaving the cooler.

2.5.4.1 Shell-and-Tube

Floating-head type consisting of a removable and cleanable nest of corrosion-resistant tubes within a steel shell. Air may pass either through the tubes or the shell.

2.5.4.2 Tube-and-Fin

Copper, aluminum, copper-aluminum, or copper-alloy construction. Fins shall be securely bonded to the tubing. Provide tube-and-fin coolers with a fan for circulation of the cooling air. The fan shall be adequately guarded for safety and be driven either from the compressor crankshaft or by an independent electric motor.

2.5.5 Noise

84 dBA maximum sound level one meter from compressor unit.

2.6 MEDIUM PRESSURE AIR RECEIVER

D.L. 93, rated for [1900] [_____] kPa (gage), equipped with required valves and trimmings, including gage and automatic drain valve and pressure safety relief valve. Pressure as indicated. [Sandblast exterior and interior to UNI EN ISO 8504-2, near-white. Lining shall be a factory applied 0.20 mm minimum epoxy coating.] Exterior finish shall be [standard factory finish] [two coats of rust inhibitor primer and one coat epoxy enamel].

2.7 MEDIUM PRESSURE COMPRESSED AIR DRYERS

****
NOTE: Make changes for medium pressure systems and insert the desired operating pressure. Normally used for under 944 scms capacity systems. CAUTION: ASSURE CORRECT SYSTEM PRESSURE IS SPECIFIED.
****

Provide medium pressure compressed air dryers of the mechanical refrigeration type, equipped with an automatic temperature shutdown switch to prevent freezing, a regenerative air to air exchanger (in capacity sizes above 5 to 28 scms as standard with the manufacturer), and a main compressed air cooling exchanger. Refrigeration system shall cool compressed air to dry the air. Dryer shall have no internal traps or filters and shall have pressure drop not greater than [21 kPa] [_____ kPa] [indicated]. Air shall leave the dryer at a temperature of [_____] degrees C and dew point of [_____] degrees C, based on an inlet temperature of [38] [_____] degrees C. Provide internal tubing, wiring, and piping complete, such that only connections to air inlet and outlet, to refrigerant compressor contactor, and to condensate drain are necessary.

2.7.1 Air Circuit

a. Regenerative heat exchanger: Inlet compressed air to outlet compressed air heat exchanger (in capacity sizes above 5 to 28 scms as standard with the manufacturer) designed to reduce cooling

load at design conditions minus 7 degrees C by inlet air precooling.

b. Main heat exchanger: Single-pass, with air in the tubes, heat sink, direct expansion, or flooded cooler type.

c. Separator: Fabricated in accordance with ASME B31.1; code stamp not required; moisture separator low velocity type incorporating change of air flow direction to prevent moisture carryover.

d. Dryer operating pressure: [1896] [_____] kPa (gage) working pressure.

e. Drain line: Provide with exterior mounted condensate trap to facilitate servicing.

2.7.2 Refrigeration System

a. Refrigeration compressor: ARI 520. Hermetic, semi-hermetic, or open reciprocating type equipped with automatic start-stop or unloading capacity control; standard components include inherent motor protection, crankcase oil strainer, and suction screen. Refrigerant shall be R407-C and R134a.

b. Dryer controls: Capable of automatic 0 to 100 percent capacity control. Refrigeration controls shall maintain pressure dew point within the specified range without freezing of condensate. Controls shall include such devices as capillary tube, expansion valve, suction pressure regulator, thermostat, or other approved devices as standard with the manufacturer. Dryer shall have automatic shutdown switch sensor located at point of lowest temperature to prevent freezing.

c. Refrigerant dryer and suction line strainer.

d. Air-cooled condenser, with condenser fan and motor.

2.7.3 Instrumentation and Control

Include control panel in dryer cabinet containing:

a. Indicators for the following services: Inlet air pressure gage, discharge air pressure gage, inlet air temperature gage, main exchanger temperature gage, refrigeration compressor suction pressure gage, refrigeration compressor discharge pressure gage, green "Power On" light, power interruption light, and high temperature light.

b. Electrical relays: Locate in an enclosed portion of the panel, accessible for ease of servicing.

c. Controls and interlocks: To maintain required compressed air dew point and to cycle air-cooled condenser with refrigeration compressor [while maintaining head pressure control with low

ambient temperature].

2.8 MEDIUM PRESSURE COMPRESSED AIR DRYER (CHILLED WATER TYPE)

****

NOTE: Edit for medium pressure systems and insert the operating pressure. Chilled water air dryers are usually provided for 944 scms and larger capacities. CAUTION: Specify correct system pressure. If specification is edited to use a dryer with direct heat exchange between air and refrigerant, assure that air is not used for breathing since refrigerant leakage into the compressed air may be hazardous to personnel; warning signs may be required.

****

Provide medium pressure compressed air dryer of the mechanical refrigerator type, with closed chilled water system, regenerative air to air exchanger, and main compressed air to water heat exchanger. Refrigeration system shall produce chilled water which, in turn, circulates through air-water exchanger to dry the air. Provide internal tubing, wiring and piping complete, such that only connections to air inlet and outlet, to pump contactor, to refrigerant compressor contactor, to condensate drain, and to air cooled condenser need be provided. Dryer shall be suitable for a compressed air operating pressure of [1896] [_____] kPa (gage), with air leaving temperature of [_____] degrees C and dew point of [_____] degrees C at rated pressure.

2.8.1 Air Circuit

a. Regenerative heat exchanger: Air to air exchanger, with inlet air passing through tubes and outlet air in shell, designed to reduce cooling load at design conditions by precooling inlet air minus 7 degrees C.

b. Main heat exchanger: Shell and tube construction, single-pass, with air in tubes and water in shell, designed for minimum air pressure drop, flanged connections, tubes rolled into tube sheets.

c. Separator: D.L. 93. Fabricated of carbon steel.

d. Drain: With condensate trap.

2.8.2 Chilled Water Circuit

a. Circulating pump: Single stage, mechanical seals, electric motor driven with line shut-off valves.

b. Liquid cooler: Direct expansion, refrigerant in tubes, water in shell, designed for 2068 kPa (gage) working pressure, removable tube bundle and insulated with foam type insulation.

c. Expansion tank: With sight glass, vent, and fill cock.

d. Flow switch: To shut down refrigeration compressor on loss of chilled water flow.

2.8.3 Refrigeration System

a. Refrigeration compressor: ARI 520. Hermetic or semihermetic reciprocating type, with 183 rad/sec motor, integral capacity control, oil pressure pump, oil scavenger pump, full-flow oil filter, oil sight glass, inherent motor protection, crankcase heater, suction and discharge service valve, crankcase oil strainer, Monel suction screen, and hot gas bypass capacity control below last step of unloading. Refrigerant shall be R407-C and R134a.

b. Accessories: Include a discharge line muffler, sight glass, refrigerant dryer, solenoid valve, thermostatic expansion valve, and suction line strainer.

c. Air-cooled condenser: As indicated. Complete air-cooled condenser factory-fabricated and assembled unit consisting of coils, fans, and electric-motor drive. Base capacity at design conditions on minus 7 degrees C temperature differential between entering air and condensing refrigerant. Saturated refrigerant condensing temperature not over 40 degrees C. Base entering dry bulb outside air temperature on [32] [_____] degrees C. Do not take subcooling into account in determining compressor and condenser capacities. Air-cooled condenser may be used for refrigerant storage in lieu of a separate receiver, provided that condenser storage capacity is 20 percent in excess of fully charged system. [Provide head pressure control during low ambient temperature.]

2.8.4 Instrumentation and Control

Provide a control panel on the dryer containing:

a. Pressure gages (114 mmdiameter) for the following services:

(1) Inlet air

(2) Condenser water inlet

(3) Refrigeration compressor suction

(4) Refrigeration compressor oil pressure

(5) Outlet air

(6) Condenser water outlet

(7) Refrigeration compressor discharge

b. Electrical relays: Locate in an enclosed portion of the panel,

accessible from front of panel.

c. Start-stop buttons and green running indicating light.

d. Controls and interlocks

(1) 220-volt control transformer

(2) Circulating pump across the line contactor

(3) Compressor across the line contactor

(4) Condenser water pressure safety switch

(5) Freeze protection safety switch

(6) Pump-out relay with normally open and normally closed contacts

(7) Oil safety switch

(8) Four stage thermostatic control

(9) Refrigerant dual pressure switch

2.8.5 Temperature Indicators

a. Air inlet

b. Air outlet

c. Chilled water in

d. Chilled water out

e. Dew point

2.9 DESICCANT AIR DRYERS

Chamber of welded steel, [_____] kPa (gage) working pressure, conforming to D.L. 93, with flanged or threaded fittings, and [manual] [automatic] drain valve. Manufacturer's recommended desiccant in tablet form which will not nest or cake. Contractor shall provide a supply of desiccant for initial operations in unbroken shipping containers equal to not less than four charges of desiccant for the dryer.

2.10 HIGH PRESSURE (HP) AIR PIPING AND ACCESSORIES

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NOTE: The high pressure air system materials listed are tentative suggestions. The designer shall calculate required minimum wall thicknesses for pipe and tube in accordance with ASME B31.1 and verify adequacy of the materials listed. Select material for corrosion resistance required in the service

environment. Allowance for corrosion or fabrication, factor "A" in ASME B31.1, paragraph 104.1, shall be selected by the designer. If carbon steel is selected as the piping material, special attention should be given to the corrosion allowance for the higher pressures such as 20,682 kPa (gage) and 34,470 kPa (gage) systems since commercial sizes per ANSI/ASME B36.10M would not permit selection of large corrosion allowance factors.

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2.10.1 HP Air Piping and Tubing

HP air piping and tubing for 34,470 kPa (gage) at 38 degrees C system shall conform to the following:

a. Stainless steel pipe: UNI EN ISO 1127 and ASTM A 312/A 312M, seamless stainless steel, annealed Type [304L] [316L], Schedule 160 up to 25 mm IPS, double extra strong (XXS) for 32 to 65 mm IPS [,larger sizes shall be special as indicated]. Wall thickness "schedule" and "weight" designations shall conform to ANSI/ASME B36.10M. Fittings for pipe 40 mm IPS and smaller: ASTM A 403/A 403M, ASME B16.11, forged stainless steel, Type [304L] [316L], socket welding, Class 6000 for 6 to 25 mm IPS, Class 9000 for 32 and 40 mm IPS. Fittings for pipe 50 to 65 mm IPS: ASTM A 403/A 403Mand UNI EN 10253-1, butt welding, seamless wrought stainless steel Type [304L] [316L], double extra strong (XXS).

b. Nickel-copper pipe: UNI EN 12449, seamless, annealed, Schedule 160 up to 25 mm IPS, double extra strong (XXS) for 32 to 80 mm IPS, [,larger sizes shall be special as indicated.] Wall thickness "schedule" and "weight" designations shall conform to UNI EN 12449. Fittings 40 mm IPS and smaller: UNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, and UNI EN 1254-5, or ASME B16.11, forged nickel-copper, socket welding, Class 6000 for 6 to 25 mm IPS, Class 9000 for 32 and 40 mm IPS. Fittings for pipe 50 mm IPS and larger: UNI EN 1254-1 and UNI EN 10253-1, butt welding, seamless wrought 70-30 nickel-copper, double extra strong (XXS), 50 to 80 mm IPS.

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NOTE: Use only one type of Mil. Spec. fitting for the entire project.

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c. Stainless steel tubing: ASTM A 269 and UNI EN ISO 1127 and, stainless steel, Type [304] [304L] [316], seamless, annealed, with wall thicknesses as specified below. Fittings for tubing: stainless steel, Type [304] [304L] [316], flared type, suitable for 34,470 kPa service. Fittings shall have a minimum burst strength of 138 MPa (gage); furnish laboratory burst test reports. Do not use flareless fittings or bite type fittings. Do not weld tubing.

MINIMUM WALL THICKNESS FOR STAINLESS STEEL TUBING

Size (mm O.D.)	Thickness (mm)
10	1.47
15	2.11
16	2.41
20	3.05

d. Copper-nickel tube: UNI EN 12449, Composition 70-30, temper-annealed, Type I - seamless Class 6000 (41,364 kPa (gage) working pressure), Grade 2 (material with heat identification), IPS outside diameter sizes. Fittings 40 mm IPS and smaller: ASME B16.11, forged copper-nickel, socket welding, except that body wall thickness shall not be less than the minimum wall thickness for Class 6000, and the average socket wall thickness shall be 1.25 times, and the minimum socket wall 1.09 times the minimum wall thickness for that size for Class 6000. Fittings 50 to 80 mm IPS: UNI EN 10253-1, butt welding, seamless wrought 70-30 copper-nickel, with minimum wall thickness for Class 6000.

2.10.2 High Pressure Air Piping

High pressure air piping for 20,682 kPa (gage) at 38 degrees C system shall conform to the following:

a. Stainless steel pipe: UNI EN ISO 1127 and ASTM A 312/A 312M, seamless stainless steel, annealed Type [304L] [316L], Schedule 80 up to 25 mm IPS, Schedule 160 32 to 150 mm IPS. Wall thickness "schedule" and "weight" designations shall conform to ANSI/ASME B36.10M. Fittings for pipe 40 mm IPS and smaller: ASTM A 403/A 403M, ASME B16.11, forged stainless steel, Type [304L], [316L], socket welding, Class 3000 for 6 to 25 mm IPS, Class 6000 for 32 and 40 mm IPS. Fittings for pipe 50 to 150 mmIPS: ASTM A 403/A 403M and UNI EN 10253-1, butt welding, seamless wrought stainless steel Type [304L] [316L], Schedule 160.

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NOTE: Use only one type of Military Specification fitting for the entire project.

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b. Stainless steel tubing: ASTM A 269 and UNI EN ISO 1127, stainless steel, Type [304] [304L] [316], seamless, annealed, with minimum wall thicknesses as specified below. Fittings for tubing: stainless steel, Type [304] [304L] [316], flared type, suitable for 20,682 kPa service. Fittings shall have a minimum burst strength of 139 MPa; furnish laboratory burst test reports. Do not use flareless fittings or bite type fittings. Do not weld tubing. Brazed 20,682 kPa tubing fittings may be used where flared fitting connections are not required for equipment. Use Grade V silver brazing alloy where tubing or fitting or both tubing and fitting are stainless steel.

MINIMUM WALL THICKNESS FOR STAINLESS STEEL TUBING

Size (mm O.D.)	Thickness (mm)
10	1.47
15	2.11
16	2.41
20	3.05

c. Copper-nickel tube: UNI EN 12449, Composition 70-30, temper-annealed, seamless, Class 3300 (22,750 kPa (gage) working pressure), Grade 2 (material with heat identification). Fittings, Brazing: bronze or copper-nickel, silver brazed ends, rated for not less than 20,682 kPa working pressure. Limit brazed joints to required connections to existing piping. Use welded joints for new and existing piping to the maximum extent practical. Fittings, welding, 40 mm IPS and smaller: ASME B16.11, forged copper-nickel, socket welding, except that body wall thickness shall not be less than the minimum wall thickness for the size listed for Class 3300, and the average socket wall thickness shall be 1.25 times, and the minimum socket wall 1.09 times the minimum wall thickness for that size listed for Class 3300; however, for 6 mm IPS, ASME B16.11, Class 3000 dimensions may be used when approved by the Contracting Officer. Fittings, welding, 50 to 80 mm IPS: UNI EN 10253-1, butt welding, seamless wrought 70-30 copper-nickel, with minimum wall thickness as for Class 3300.

2.10.3 Globe and Angle Valves

High pressure valve with bronze body.

2.10.4 Needle Valves

High pressure valve with bronze body, except provide needle valve cartridges in lieu of shutoff valve cartridges.

2.10.5 Safety Valves

UNI 9335 safety valve, [Type [304L] [316L] stainless steel,] [70-30 copper-nickel,] [70-30 nickel-copper,] [bronze,] [carbon steel,] with 0-ring seal union thread piece ends; factory set and sealed.

2.10.6 Pressure Reducing Valves

UNI EN 1567, nominal pressure rating of [2758] [10,341] [20,680] [41,364] kPa (gage), body of [stainless steel,] [bronze,] [aluminum bronze,] [naval brass,] outlet pressure and capacity as indicated, shock and vibration test not required, allowance lists not required.

2.10.7 Adapters

Provide suitable tailpiece adapters for installation of valves and for other components with similar union end connections. Tailpieces shall match pipe material: [Type 304L or 316L stainless steel,] [70-30

nickel-copper,] [70-30 copper-nickel,] socket welding type for 40 mm IPS and smaller. Tailpieces for tubing: [brazed O.D. type suitable for 20,682 kPa]. Provide thread piece adapters for O-ring union installation of components made of material different from pipe or where welded joint installation is not suitable.

2.10.8 Pressure Gages (High Pressure)

Pressure gages for high pressure systems shall conform to UNI EN 837-1, UNI EN 837-2, and UNI EN 837-3, or ANSI/ASME B40.1, for air, with a scale approximately twice the system working pressure, nonshatterable safety glass, and pressure blowout back to prevent glass from flying out in case of an explosion. Gages: [90] [114] mm in diameter with a steel case and tubing and an accuracy of one percent full scale in middle half section of scale and 1 1/2 percent of full scale value in first and last 1/4 sections of scale. Do not fasten bourdon tube pressure-sensitive elements with low-melting-point solder. Print on gage faces in red letters "USE NO OIL." Provide pressure snubbers or equalizer in pressure gage installations on inflow side of a gage valve. Mount gage branches vertically on top of an air line to avoid branch flow of condensate and dirt. Connect a gage to an air line or component through an equalizer, gage valve (slow-opening needle type), and branch with provision for bleed-off.

2.10.9 Snubbers (or Equalizers)

[Type 304L or Type 316L stainless steel] [70-30 copper-nickel] [70-30 nickel-copper] body with a rated working pressure not less than system design pressure. Snubber element: sintered stainless steel or other approved type.

2.10.10 Timed Solenoid Drain

Packaged solenoid drain with 6 mm, [20,682] [34,470] kPa (gage), direct acting, normally closed solenoid valve, solid state timer, drain cycle adjustable from zero to 50 minutes, valve open duration adjustable from one to 14 seconds, power on light, valve open light, operation on 230 VAC, and housed in CEI [1] [_____] enclosure.

2.10.11 Compressed Air Filters

Provide high pressure compressed air filter, single cartridge type, designed for operating pressures not less than the system design pressure. Filter housing of [Type [304L] [316L] stainless steel] [70-30 copper-nickel] [70-30 nickel-copper] construction. Provide a cellulose cartridge filter of graded density construction capable of removing liquids and solids of 5 microns and larger. Provide filter with a bottom drain and [manual drain valve] [timed solenoid drain], per UNI 9647.

2.10.12 Strainers

Y-pattern type with [cast stainless steel body, Type 316, Type 304, Type 304L or Type 316L,] [70-30 copper-nickel,] [70-30 nickel-copper,] [forged alloy steel body ASTM A 182/A 182M, Grade F-22,] rated for the system design working pressure, with 20-mesh Monel or stainless steel screen. Net

strainer area not less then 2.5 times the inlet connection area.

2.10.13 Unions

O-ring seal type compatible with union ends of valves, material and end preparation compatible with pipe and fittings.

2.10.14 O-Ring Gaskets

UNI ISO 3601-1.

2.10.15 Hangers and Supports

Provide pipe hangers and supports conforming to UNI 5311 and UNI 7145, except as specified or indicated otherwise. Hangers for high pressure air lines shall be rigid or braced and sufficiently strong to prevent "whipping" of a pipe if a break occurs while the line is under pressure. Furnish zinc plated pipe hangers and supports except for copper plated inserts for copper piping. Provide tubing supports of U-shaped steel bolts and nuts firmly secured to adequately support structures such as walls, columns, floors, or brackets. Clips shall fit closely around piping but shall have sufficient clearance to permit longitudinal movement of piping during normal expansion and contraction. Provide supports at valves, fittings, branch lines, outlets, changes in direction, equipment, and accessories.

2.11 MEDIUM PRESSURE COMPRESSED AIR PIPING AND ACCESSORIES

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NOTE: Components are listed based on operation at maximum temperature of 66 degrees C. Class 300 steam rated components have water-oil-gas (WOG) ratings above 2758 kPa (gage) at 66 degrees C. If higher operating temperatures are expected, change component descriptions to higher ratings as required after reviewing appropriate component specification.

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Medium pressure compressed air piping and accessories 869 to 2751 kPa (gage) at 66 degrees C shall conform to the following:

2.11.1 Pipe

ASTM A 53 or UNI EN 10216-1 and UNI 8863/FA-1, seamless carbon steel, Schedule 40, black.

2.11.2 Fittings, Size 50 Millimeters and Larger

UNI EN 10253-1, carbon steel, butt welding, Schedule 40, or UNI 2223 and UNI 2278, carbon steel welding neck flanges, Class 300, UNI 2223, flanged fittings, carbon steel, Class 300, gaskets ASME B16.20, spiral wound metallic, Class 300, bolts UNI 6609, Grade B7, and nuts, UNI 3740-1, Grade 7. Butt welded joints shall be full penetration consumable insert or backing ring type.

2.11.3 Fittings, Size 40 Millimeters and Smaller

ASME B16.11, forged carbon steel, Class 3000 socket welding or Class 2000 threaded. Seal weld threaded joints not required to disassemble piping for maintenance. Joints may also be butt welded or flanged, as specified for sizes 50 mm and larger.

2.11.4 Flat-faced Steel Flanges

Where connections are made to Class 250 cast iron flanges with steel flanges, use only flat-faced Class 300 steel flanges.

2.11.5 Unions

UNI EN 10242 (3447 kPa (gage) WOG, cold, non-shock).

2.11.6 Valves

2.11.6.1 Globe and Angle Valves

Sizes 50 mm and smaller, bronze, metallic disc, renewable seat type, Class 300, threaded ends, or carbon steel, Class 300, threaded ends. Sizes larger than 50 mm, UNI 6884 or ASME/ANSI B16.34, carbon steel, tapered disk, Class 300, flanged ends.

2.11.6.2 Check Valves

UNI EN 1074-3 and UNI 6884 or ASME/ANSI B16.34, Class 300, steel, lift or swing type.

2.11.6.3 Pressure Reducing Valves

UNI EN 1567, with nominal pressure rating of not less than inlet system pressure indicated. Provide pressure reducing valves capable of being adjusted to specified flow and pressure, and suitable for intended service. Provide pilot valve for dome loaded type if required for proper operation.

2.11.6.4 Safety Valves

UNI 9335 safety valve, bronze body with bronze trim, for unfired pressure vessels, threaded or flanged connection; factory set and sealed.

2.11.7 Pressure Gages

UNI EN 837-1, UNI EN 837-2, UNI EN 837-3, and UNI 4668, or ANSI/ASME B40.1, Accuracy Grade A, for air, with steel or brass case, and nonshatterable safety glass, and a pressure blowout back to prevent glass from flying out in case of an explosion. Gages shall have a 90 mm minimum diameter dial and a dial range of approximately twice working pressure.

2.11.8 Pipe Hangers and Supports

UNI 5311, UNI 7145, except as specified or indicated otherwise. Provide

zinc plated pipe hangers and supports. Provide tubing supports of U-shaped steel bolts and nuts firmly secured to adequately support structures such as walls, columns, floors, or brackets. Clips shall fit closely around piping but shall have sufficient clearance to permit longitudinal movement of piping during normal expansion and contraction. Provide supports at valves, fittings, branch lines, outlets, changes in direction, equipment, and accessories.

2.11.9 Strainers

Class 250, Style Y, simplex type, with 20-mesh Monel or stainless steel screen.

2.11.10 Traps

UNI EN 26704, to drain water and other liquids from system. Type of traps, as indicated, and rated working pressure not less than system operating pressure.

2.11.11 Flexible Connections

Vibration isolation, wire braid reinforced corrugated metal hose type, line-sized, with bronze end connections, suitable for pressure indicated. Length as recommended by manufacturer but not less than [457] [_____] mm.

2.11.12 Tetrafluoroethylene Tape

Tetrafluoroethylene tape for screw-jointed pipe.

2.12 SLEEVES

2.12.1 Floor Slabs, Roof Slabs, and Outside Walls Above and Below Grade

Galvanized-steel pipe having an inside diameter at least 15 mm larger than the outside diameter of the pipe passing through it. Provide sufficient sleeve length to extend completely through floors, roofs, and walls, so that sleeve ends are flush with finished surfaces except that ends of sleeves for floor slabs shall extend 15 mm above finished floor surface. Sleeves located in waterproofed construction shall include flange and clamping ring.

2.12.2 Partitions

Galvanized sheet steel, 26 gage or heavier, of sufficient length to completely extend through partition thickness with sleeve ends flush with partition finished surface.

2.13 VALVE BOX

Provide rectangular concrete design with words "Compressed Air" cast or otherwise marked on the cover. Size shall be large enough for removal of valve without removing box. Provide valve box for areas as follows:

a. Roads and traffic areas: Heavy Duty, cast iron cover

b. Other areas: Standard duty, heavy steel plate or concrete cover

2.14 IDENTIFICATION LABELS FOR PIPING

Labels for pipes 20 mm O.D. and larger shall bear printed legends to identify contents of pipes and arrows to show direction of flow. Except that of pipes smaller than 20 mm O.D., labels shall have color coded backgrounds to signify levels of hazard in accordance with UNI 5634. Legends and type and size or characters shall also conform to UNI 5634. Labels shall be made of plastic sheet with pressure-sensitive adhesive suitable for the intended applications or they may be premolded of plastic to fit over specific pipe outside diameters 20 mm and larger. For pipes smaller than 20 mm O.D., furnish brass identification tags 40 mm in diameter with legends in depressed black-filled characters.

2.15 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

Polyethylene plastic tape manufactured specifically for warning and identification of buried utility lines. Tape shall be of the type provided in rolls, 152 mm minimum width, color codes for compressed air (gray) with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION BURIED COMPRESSED AIR LINE BELOW" or similar wording in both English and Italian. Code and letter coloring shall be permanent, unaffected by moisture and other substances contained in trench backfill material.

2.16 FRESH WATER

Fresh water for cleaning, flushing, and testing shall be clean and potable.

2.17 BASIC PIPING AND COMPONENT MATERIALS

Conform to the following where material is specified by generic type and no specification is listed.

2.17.1 Stainless Steel

Austenitic type, annealed, ASTM A 182/A 182M.

2.17.2 Nickel-Copper

70-30 nickel-copper, annealed, UNI 2528-1.

2.17.3 Copper-Nickel

70-30 copper-nickel, soft temper, UNI 2528-1.

2.17.4 Other Materials

For materials where no specification is listed above, conform to material specifications listed in ASME B31.1.

2.18 SOURCE QUALITY CONTROL

Test air compressors and compressed air dryers at the factory to assure proper operation. Certify satisfactory accomplishment of tests.

PART 3 EXECUTION

3.1 INSTALLATION

Install materials and equipment as indicated and in accordance with manufacturer's recommendations.

3.1.1 Excavation and Backfilling

Section 02315, "Excavation and Fill."

3.1.2 Corrosion Protection

Provide corrosion protection for buried steel [and corrosion resistant steel] piping in accordance with Section 09974 "Protection of Buried Steel Piping and Steel Bulkhead Tie Rods."

3.1.3 Piping

Unless specifically stated to the contrary, fabrication, assembly, welding, and brazing shall conform to ASME B31.1 for all piping of the air system. Piping shall follow the general arrangement shown. Cut piping accurately to measurements established for the work. Work piping into place without springing or forcing, except where cold-springing is specified. Piping and equipment within buildings shall be entirely out of the way of lighting fixtures and doors, windows, and other openings. Locate overhead piping in buildings in the most inconspicuous positions. Do not bury or conceal piping until it has been inspected, tested, and approved. Where pipe passes through building structure, pipe joints shall not be concealed, but shall be located where they may be readily inspected and building structure shall not be weakened. Avoid interference with other piping, conduit, or equipment. Except where specifically shown otherwise, vertical piping shall run plumb and straight and parallel to walls. Piping connected to equipment shall be installed to provide flexibility for vibration. Adequately support and anchor piping so that strain from weight of piping is not imposed on the equipment.

3.1.3.1 Fittings

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NOTE: Delete bending of medium or high pressure pipe when not included in project.

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Use long radius ells where appropriate to reduce pressure drops. Pipe bends in lieu of fittings may be used for piping where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and must be free from any appreciable flattening, wrinkling, or thinning of the pipe. Mitering of pipe to form elbows, notching straight runs to form

full sized tees, or any similar construction shall not be used. Make branch connections with welding tees, except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.1 may be used.

a. Bending of High Pressure Pipe: Prior to bending pipe for high pressure systems, the Contractor shall submit for approval written fabrication and inspection procedures and calculations showing the required minimum wall thickness of pipe after bending. Only cold bending shall be permitted. The fabrication procedure shall indicate the required pipe wall thickness prior to bending, equipment to be used, set up and bending procedures, and inspection and acceptance criteria. Inspection shall include verification of minimum wall thickness by ultrasonic or other methods if deemed necessary by the Contracting Officer. No wrinkles or other contour irregularities will be permitted in the bent pipe. Check flattening in accordance with ASME B31.1. Include required dimensional checks in inspection procedures and acceptable values tabulated for each pipe size to be bent. Qualified personnel shall perform nondestructive examinations required in accordance with qualified procedures.

3.1.3.2 Clearances for Welding

Provide clearances from walls, ceilings, and floors to permit the installation of joints. The clearances shall be at least 150 mm for pipe sizes 100 mm and less, 250 mm for pipe sizes over 100 mm, and sufficient in corners. However, the specified clearances shall not waive requirements for welders to be qualified for the positions to be welded.

3.1.3.3 Cleaning

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NOTE: Special cleaning requirements are mainly intended for high pressure systems. Special cleaning should also be considered for medium pressure systems over 1724 kPa (gage) which may be subject to dieseling explosions when oil contamination is present. Objective cleaning standards are specified to simplify inspection and acceptance in the field.

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Before jointing and erection of piping or tubing, thoroughly clean interiors of pipe sections, tube, and components. In steel pipe, loosen scale and other foreign matter by rapping sharply and expel by wire brush and swab. Blow out both steel pipe and copper tube and components with compressed air at 690 kPa (gage) or more. Maintain cleanliness by closure of pipe/tube openings with caps or plugs. Before making final terminal connections, blow out complete system with compressed air at 690 kPa (gage) or more. Cleaning and cleanness of medium pressure systems over 1724 kPa (gage) and high pressure systems shall conform to the paragraph entitled "Cleaning and Cleanness Requirements."

3.1.3.4 Changes in Pipe Size

Use reducing fittings for changes in pipe size. The use of bushings will not be permitted. In horizontal lines, 65 mm and larger, reducing fittings shall be of the eccentric type to maintain the bottom of the lines in the same plane.

3.1.3.5 Drainage and Flexibility

Compressed air piping shall be free of unnecessary pockets and pitched approximately one mm per 400 mm in the direction of flow to low points. Where pipes must be sloped so that condensate flows in opposite direction to air flow, slope one mm per 200 mm or greater. Provide flexibility by use of fittings, loops, and offsets in piping. Install branches at top of a main to prevent carryover of condensate and foreign matter.

3.1.4 Threaded Joints

Where possible use pipe with factory cut threads, otherwise cut pipe ends square, remove fins and burrs, and cut taper pipe threads in accordance with UNI ISO 7-1 and UNI 4648. Threads shall be smooth, clean, and full cut. Apply thread tape to male threads only. Work piping into place without springing or springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed.

3.1.5 Flanged Joints in High Pressure System

Install using calibrated torque wrenches or feeler gage methods to assure proper gasket compression. Calibrate torque wrench immediately prior to use.

3.1.6 Welding and Brazing

Perform welding and brazing in accordance with qualified procedures using qualified welders and welding operators and brazers. Do not perform welding and brazing when the quality of the completed weld or braze could be impaired by the prevailing working or weather conditions. The Contracting Officer will determine when weather or working conditions are unsuitable for welding. Welding of hangers, supports, and plates to structural members shall be in accordance with UNI EN ISO 13920. Mark welding and brazing detail drawings to identify the welder or brazer making the joint.

3.1.6.1 Cleaning for Welding and Brazing

Surfaces to be welded or brazed shall be free from loose scale, slag, rust, paint, oil, and other foreign material. Joint surfaces shall be smooth and free from defects which might affect proper welding. Clean each layer of weld metal thoroughly by wire brushing, grinding, or chipping prior to inspection or deposition of additional weld metal. Conform to paragraph entitled "Cleaning and Cleanness Requirements" [for medium pressure systems over 1724 kPa (gage)] [and] [for high pressure] systems.

3.1.6.2 Stress Cracking During Brazing

For austenitic stainless steel and other material susceptible to stress corrosion cracking from molten brazing filler metal, avoid applying stress during brazing.

3.1.6.3 Welding or Brazing of Valves

Welding or Brazing of Valves: Disassemble valves subject to damage from heat during welding or brazing and reassemble after installation. Open valves two or three turns off the seat when not subject to heat damage during welding or brazing; do not backseat valve.

3.1.7 Valves

Install valves in conformance with ASME B31.1 at the locations indicated and elsewhere as required for the proper functioning of the system.

3.1.7.1 Globe Valves

Install globe valves so that the pressure will be below the disk. Install globe valves with the stems vertical.

3.1.7.2 Pressure-Reducing Valves

Provide compressed air entering each pressure-reducing valve with a strainer. Provide each pressure-reducing valve unit with two block valves and with a globe or angle bypass valve and bypass pipe. Provide a bypass around a reducing valve of reduced size to restrict its capacity to approximately that of the reducing valve. Provide each pressure reducing valve unit with an indicating gage to show the reduced pressure, and a safety valve on the lower pressure side. These requirements do not apply to small pressure regulating valves used to adjust pressure for pneumatic equipment.

3.1.8 Hangers and Supports

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NOTE: See NAVFAC P-355, "Seismic Design for Buildings," Chapter 10, "Mechanical and Electrical Elements," for calculating pipe support spacing for schedules not shown. Also, space supports for high pressure air piping to provide restraint against whipping and damage to other piping if the high pressure line breaks; see DM 3.5, "Compressed Air and Vacuum Systems," Section 7, "Piping Systems." Delete Table I and reference to seismic requirements if not required.

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Selection, fabrication and installation of piping hangers and supports shall conform to UNI 5311, UNI 7145 [except that spacing of the hangers and supports shall be as per Table I.]

TABLE I. MAXIMUM SPAN FOR PIPE

DIAMETER MM	STD. WT. STEEL PIPE SCHEDULE 40	EX. STRONG STEEL PIPE SCHEDULE 80
15	1.52	1.52
20	1.75	1.75
25	1.98	1.98
40	2.29	2.36
50	2.59	2.59
65	2.82	2.90
80	3.125	3.20
90	3.35	3.35
100	3.51	3.58
125	3.89	3.96
150	4.19	4.27
200	4.73	4.88
250	5.18	5.34
300	5.56	5.79

3.1.9 Pressure Gages

Provide pressure gages with a shut-off valve or petcock installed between the gage and the line.

3.1.10 Strainers

Provide strainers with meshes suitable for the services where indicated, or where dirt might interfere with the proper operation of valve parts, orifices, or moving parts of equipment.

3.1.11 Equipment Foundations

Provide equipment foundations of sufficient size and weight and of proper design to preclude shifting of equipment under operating conditions or under any abnormal conditions which could be imposed upon the equipment. Provide foundations which meet the requirements of the equipment manufacturer, and when required by the Contracting Officer, obtain from the

equipment manufacturer approval of the foundation design and construction for the equipment involved. Equipment vibration shall be maintained within acceptable limits, and shall be suitably dampened and isolated.

3.1.12 Equipment Installation

Install equipment strictly in accordance with these specifications, and the manufacturers' installation instructions. Grout equipment mounted on concrete foundations before piping is installed. Install piping in a manner that does not place a strain on any of the equipment. Do not bolt flanged joints tight unless they match properly. Extend expansion bends adequately before installation. Grade, anchor, guide and support piping without low pockets.

3.1.13 Cleaning of System

****

NOTE: Special cleaning requirements are mainly intended for high pressure systems. Special cleaning should also be considered for medium pressure systems over 1724 kPa (gage) which may be subject to dieseling explosions when oil contamination is present. Objective cleaning standards are specified to simplify inspection and acceptance in the field.

****

Clean the various system components before final closing as the installations are completed. Remove foreign matter from equipment and surrounding areas. [Cleaning and cleanliness shall conform to paragraph entitled "Cleaning and Cleanliness Requirements" for pressures over 1724 kPa (gage).] Preliminary or final tests will not be permitted until the cleaning is approved by the Contracting Officer.

3.1.14 Pipe Sleeves

Provide pipe sleeves where pipes and tubing pass through masonry or concrete walls, floors, roofs, and partitions. Hold sleeves securely in proper position and location before and during construction. All sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Extend sleeves in floor slabs 50 mm above the finished floor. Pack space between the pipe or tubing and the sleeve firmly with oakum and caulk both ends of the sleeve with elastic cement.

3.1.15 Floor, Wall, and Ceiling Plates

Provide chromium-plated steel or nickel-plated cast iron plates on pipes passing through floors and partitions of finished rooms. Provide painted cast-iron, malleable iron, or steel for other areas.

3.1.16 Flashing for Buildings

Provide flashing [as required] [in accordance with Section 07600 "Flashing and Sheet Metal"] where pipes pass through building roofs and outside walls.

3.1.17   Unions and Flanges

Provide unions and flanges where necessary to permit easy disconnection of piping and apparatus, and as indicated. Provide a union for each connection having a screwed-end valve. [Provide unions or flanges not farther apart than 30 meters.] [Provide unions or flanges as indicated.] Provide unions on piping under 50 mm in diameter, and provide flanges on piping 50 mm and over in diameter. Install dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous to non-ferrous connections.

3.1.18   Painting of Piping and Equipment

Paint piping and equipment in accordance with Section 09900 "Paints and Coatings."

3.1.19   Identification of Piping

Identify piping in accordance with UNI 5634. Use commercially manufactured piping identification labels. Space identification marking on runs not farther apart than 15 meters. Provide two copies of the piping identification code framed under glass and install where directed.

3.1.20   Warning and Identification Tape

Coordinate installation of utility warning and identification tape with backfill operation. Provide tape above buried lines at a depth of 200 to 305 mm below finish grade.

3.2   CLEANING AND CLEANNESS REQUIREMENTS

****

NOTE: Special cleaning requirements are mainly intended for high pressure systems. Special cleaning should also be considered for medium pressure systems over 1724 kPa (gage) which may be subject to dieseling explosions when oil contamination is present. Objective cleaning standards are specified to simplify inspection and acceptance in the field.

****

Cleaning and cleanness requirements shall conform to the following.

3.2.1   Prohibited Methods and Processes

The following methods and processes shall not be used.

a. Chemical descaling (acid pickling).

b. Abrasive blasting and vapor blasting.

c. Alkaline cleaning.

d. Emulsion cleaning.

e. Chelate cleaning.

f. Acid cleaning

g. Passivation.

h. Corrosion inhibitors shall not be used.

3.2.2 Approval of Methods and Procedures

Prepare and submit written cleaning procedures for approval. Perform production cleaning in accordance with approved procedures.

3.2.3 Tools Used on Corrosion-Resistant Alloys

Tools used on corrosion-resistant alloys such as grinding, polishing, filing, deburring, and brushing tools shall be visually clean and shall not have been used on carbon or low alloy steels, aluminum, lead or materials containing lead or lead components, or other low melting point materials. Wire brushes shall be 300 series stainless steel. Unless otherwise approved, each tool shall be used on only one type of corrosion-resistant metal.

3.2.4 Cleaning Before Installation

Clean piping, components, and equipment before installation.

3.2.5 Cleaning Requirements

Clean surfaces containing no crevices or inaccessible areas by any of the procedures described herein. Clean surfaces containing crevices by immersion in unused or redistilled acetone, ethanol, or isopropanol only.

3.2.5.1 Vapor Degreasing

Vapor degreasing may be used on surfaces containing no crevices or inaccessible areas and shall be accomplished by the following procedures:

a. Dry all parts entering degreaser.

b. Load parts onto racks in the condensing zone so that they do not touch each other, and in such a manner to insure complete draining of solvents.

c. Use perchloroethylene bath. Maintain bath at 121 to 127 degrees C . The bath shall contain a neutral inhibitor to prevent acid formation due to hydrolysis. Other types of inhibitors are not permitted.

d. Change solvent when boiling point of perchloroethylene exceeds 127

degrees C. Dump solvent earlier if cleanliness standards are not attained.

e. Lower or raise parts in the degreaser at a rate not to exceed 5 mm/s and immerse in vapor phase. Spray with clean solvent during immersion time. Keep the spray nozzle at least 305 mm below the vapor line during spraying. Allow part to remain in vapor until condensation ceases (3 to 5 minutes). Dry parts completely before removing from degreaser.

3.2.5.2 Degreasing by Immersion or Wiping

Degreasing of parts having no inaccessible areas or crevices may be performed by immersion in solvent or by wiping with a clean lintless wiping cloth saturated with the solvent perchloroethylene, unused or redistilled acetone, ethanol, or isopropanol, or Stoddard solvent for preliminary degreasing. Dry in accordance with paragraph entitled "Drying Requirements."

3.2.5.3 Trisodium-Phosphate Detergent Cleaning (Degreasing)

Trisodium-phosphate detergent cleaning may be used on surfaces containing no crevices or inaccessible areas and shall be accomplished as follows:

a. Remove heavy dirt by either scrubbing with a non-shedding bristle brush using a solution of up to 112.2 mL of nonionic detergent per liter of tap water or immersing the parts in a hot (approximately 71 - 88 degrees C) solution consisting of 207 to 296 mL of trisodium phosphate and up to 112.2 mL of the nonionic detergent per liter of tap water for about 20 minutes. Agitate and use brush as necessary.

b. Rinse parts thoroughly in hot water at a minimum of 49 degrees C.

c. Dry the parts in accordance with paragraph entitled "Drying Requirements."

3.2.5.4 Ultrasonic Cleaning

Cleaning methods using ultrasonic equipment may be used.

3.2.6 Drying Requirements

Accomplish drying by still or forced clean air or inert gas, drying oven, or by evacuation. When using evacuation, exercise care to prevent evacuating-pump lubricant from entering the equipment. Check compressed air used for drying to ensure cleanliness by blowing through a clean, white, cotton filter cloth for about 5 minutes at full drying velocity.

3.2.7 Inspection and Acceptance Criteria for Cleanliness

Conform to the following:

3.2.7.1 Cleanness Criteria

All surfaces of piping material, equipment, instruments, and other components which will come in contact with compressed air shall be clean to the extent that no contamination is visible to a person with normal visual acuity (natural or corrected) under a lighting level of at least 1076 lux on the surface being inspected. Cleanness of surface which cannot be visually inspected due to inaccessibility or geometry shall be determined by an interpretation of the discoloration or dirt obtained by wiping with a clean, white, wet or dry cloth. Free of contamination shall mean free of oil, dirt, metallic flakes, preservatives, paint, and any other substances which may present a safety hazard or impair the quality of the compressed air.

3.2.7.2 Critical Surfaces

No rust shall be allowed on valve seats, orifice plates or other critical surfaces. Thin films of rust are acceptable on other corrosion-resistant material surfaces provided there is no visible thickness or evidence of pitting and the total area involved does not exceed one percent of the total surface area of the component in contact with compressed air.

3.2.7.3 Carbon and Low Alloy Steels

A uniform light rust that can be removed by brushing or wiping is acceptable.

3.2.8 Maintaining Cleanness During Installation

Maintain cleanness of piping, components, and equipment during installation. Dirt and debris producing operations shall be performed so that dirt and debris fall away from system openings; otherwise, provide covers over openings to preclude contamination. Cap, plug, cover, or bag openings and pipe ends and secure with tape when they are not required to be open for the performance of work. Metal caps, plugs, and covers shall be austenitic stainless steel. Plastic items and tape shall be free of substances that can have a harmful effect on stainless steel and other corrosion-resistant metals in the system.

3.2.9 Cleanness Verification Flushes

After installation, check the systems for cleanness by flushing with water. Perform flushing so that the minimum velocity through any part of the system is not less than [1.1] [_____] meters per second. Pass flush water through a filter for cleanness evaluation. Filter element shall be corrosion-resistant wire cloth with mesh size conforming to ASTM E 11, No. 20 (850 micrometers), No. 25 (710 micrometers), or No. 30 (600 micrometers). Filter area shall be sufficient to limit pressure drop so that required flushing velocity can be attained.

3.2.9.1 Flush Acceptance Criteria

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NOTE: Select flush acceptance criteria based on how critical the system is and the volume of system to

be flushed. More particles may be expected and may be acceptable in larger systems.

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The system shall be flushed until there is no more than [slight speckling] [[0.1] [0.5] [_____] cubic centimeters] of particulates on the filter screen. There shall be no particles larger than 0.79 by 1.59 mm long. The flush water shall show no visual evidence of contamination such as oil particles, discoloration, or iridescent surface film characteristic of oil.

3.2.9.2 Recleaning of Systems

Systems which fail to meet acceptance flush criteria after flushing for more than 4 hours shall be recleaned by the Contractor at no additional cost to the Government. Prepare recleaning procedures and submit to the Contracting Officer for approval. Remove instruments, components, and any other items that may be damaged by recleaning. Perform recleaning by flushing with hot water at not less than 60 degrees C.

3.3 CLEANING SILVERBRAZED PIPING

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NOTE: All silverbrazed piping, including low pressure systems, should be cleaned to preclude corrosion from residual brazing flux.

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Clean silverbrazed piping to remove residual flux remaining in the system after fabrication. Use one of the procedures below. The hot flush and hot recirculating flush are preferred. Minimum flow rate through any part of the system in liters per second shall be 0.0037 times the inside diameter of the pipe in mm. For any flushing method used, the system shall be full of water so that joints are completely submerged at all times.

3.3.1 Hot Flushing Method

Hot flush the system for one hour using heated fresh water. No part of the system shall go below 43 degrees C.

3.3.2 Hot Recirculating Flush Method

Perform hot recirculating flush for one hour. Heat water during flushing so that no part of the system falls below 43 degrees C. After completing the hot recirculating flush, flush the system with cold fresh water for 15 minutes.

3.3.3 Cold Soak Method

Cold soak the system using fresh water at not less than 15.50 degrees C for 12 hours. Following the 12 hour soak, flush the system with fresh water at not less than 15.50 degrees C for 4 hours.

3.4 FIELD QUALITY CONTROL

3.4.1 Examinations

3.4.1.1 Welding Examinations

****
NOTE: The paragraphs will be edited and inserted if necessary to ensure proper implementation of the "CONTRACTOR QUALITY CONTROL PROGRAM." The specification writer or design engineer must indicate how much quality control of welding is needed for each project and who is to be responsible, i.e., primarily the Contractor or the Government. Rarely will a project require 100 percent testing of welds by NDE methods. The designer must determine the required methods and the extent of inspection and testing and must indicate the extent in this section of the project specifications or on the project drawings by notes, nondestructive test symbols, or other means. Table II at the end of this section was developed from MIL-STD MIL-STD-278, "Fabrication, Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels in Ships of the United States Navy." The referenced applicable publications and Army Technical Manual, "WELDING DESIGN, PROCEDURES AND INSPECTION," TM-5-805-7, may be used for guidance in determining inspection and testing requirements. The specifications or drawings must clearly indicate which joints require 100 percent NDE inspection, which joints require random NDE inspection, and which NDE methods are to be employed for each joint. For random inspection, the drawings must indicate the location, number of joints, and minimum increment length of weld that will be subject to NDE inspection without predisclosing the exact spots to be examined. Joints not indicated to be tested by NDE methods shall be subject to visual inspection only. In cases where the nature of the welding is such as to require visual inspection only, the requirements for other nondestructive examinations should be deleted from these paragraphs and from paragraph entitled "QUALIFICATION OF INSPECTION AND NONDESTRUCTIVE PERSONNEL."
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NOTE: Information based on Table II must be developed and included in each project specification. Table must clearly define the systems to be inspected and the type of NDE required. Revise Table II if required for the project.
****

[The Government will] [The Contractor shall] perform visual and nondestructive examinations to detect surface and internal discontinuities in completed welds. Submit a NDE report meeting the requirements specified in ASME B31.1. [The Contractor shall obtain the services of a qualified commercial inspection or testing laboratory or technical consultant, approved by the Contracting Officer.] Visually examine welds. Perform [radiographic,] [liquid penetrant,] [or] [magnetic particle] examination as specified in Table II of this section. For systems operating at 6894 kPa (gage) or higher, all welds shall be examined. For high pressure systems operating less than 6894 kPa (gage), perform random NDE. When examination and testing indicate defects in a weld joint, the weld shall be repaired by a qualified welder. Remove and replace defects as specified in ASME B31.1, unless otherwise specified. Repair defects discovered between weld passes before additional weld material is deposited. Whenever a defect is removed, and repair by welding is not required, blend the affected area into the surrounding surface, eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, examine the area by the same test methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by surface conditioning [and NDE] shows that no unacceptable defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

3.4.1.2 Brazing Examinations

The Contractor shall perform brazing examinations.

a. Visual Examinations

Visually examine all compressed air systems as follows:

(1) Check brazed joint fit-up. Diametrical clearances shall conform to brazing procedure requirements.

(2) Check base material of pipe and fitting for conformance to the applicable drawing or specification.

(3) Check grade of brazing alloy for conformance to the brazing procedure before fit-up or brazing.

(4) Check completed brazed joint for a complete ring of brazing alloy between the outside surface of the pipe and the face of the fitting, and for a visible fillet.

(5) Check stainless steel and other susceptible material for evidence of stress cracks. Check inside of joint if possible with borescope or other aids.

b. Nondestructive Examination

For high pressure compressed air systems, any fitting, copper-nickel pipe,

or stainless steel tubing which is reused after unsweating a brazed joint shall be liquid penetrant examined for cracks. Any crack detected shall be cause for rejection of the fitting or pipe. Liquid penetrant examination shall be performed by qualified personnel.

c. Repair of Brazed Joints

Defective joints may be repaired. However, no more than two attempts to repair by reheating and additional face feeding of brazing filler metal will be permitted, after which the defective joint shall be unsweated, reprepared as a new joint, examined for defects on pipe and fittings, and rebrazed. Perform required NDE.

3.4.2 Testing

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NOTE: If air (pressure) drop tests are used for system acceptance, assure that leakages at acceptable rates through valves (or other components) are not causing pressure drop. Most hard-seated valves have some allowable leakage rate (about 10 cubic centimeters per hour of water per 25 mm valve size or 3 liters per hourof gas per 25 mm of valve size). Delete check for cross-connection if only one type of system is involved in project.

****

3.4.2.1 General Requirements, Testing

Perform testing after cleaning and acceptance of cleanness. Contractor shall provide everything required for tests. Tests shall be subject to the approval of the Contracting Officer. Calibrate the test pressure gage with a dead weight tester within [15] [_____] days before use and certify by initial and date on a sticker applied to dial face. [Pressurize each piping system individually and check to assure that there are no cross-connections between different systems prior to hydrostatic and operational tests.]

a. Supervision of Testing

For [high] [and] [medium] pressure system, an experienced registered professional engineer responsible for safety and employed by the Contractor shall be present during testing.

3.4.2.2 Hydrostatic and Leak Tightness Tests

a. Preliminary Preparation

Remove or isolate from the system the compressor, air dryer, filters, instruments, and equipment which would be damaged by water during hydrostatic tests and reinstall after successful completion of tests.

b. Performance of Hydrostatic Tests

****

NOTE: Specify or show on the drawings the design working pressure of each system in the project.

****

Hydrostatically test piping systems in accordance with ASME B31.1. Vent or flush air from the piping system. Pressurize system for 10 minutes with water at one and one-half times design working pressure, then reduce to design working pressure and check for leaks and weeps.

c. Compressed Air Leak Tightness Test

After satisfactory completion of hydrostatic pressure test, blow systems dry with clean, oil-free compressed air, and test with clean, dry air at design working pressure. Brush joints with soapy water solution to check for leaks. Install a calibrated test pressure gage in piping system to observe any loss in pressure. Maintain required test pressure for a sufficient length of time to enable an inspection of joints and connections.

d. Compressed Air Pressure Test For High Pressure Systems

For high pressure systems, compressed air at system design pressure shall then stand in a system to equalize temperature. Pressure drop, corrected for temperature change, shall not be more than one percent in 24 hours for a test pressure 6894 kPa (gage) and above, and not over 5 percent in 6 hours for test pressures from 2758 to 6894 kPa (gage). Use formula below to correct pressure for temperature change.

$$PF + 101.32 = (PI + 101.32)(TF + 273)/(TI + 273)$$

Where PF = Final Pressure, (kPa (gage))

PI = Initial Pressure, (kPa (gage))

TF = Final Temperature, (degrees C)

TI = Initial Temperature (degrees C)

3.4.2.3 Operational Tests

Test equipment as in service to determine compliance with contract requirements and warranty. During the tests, test equipment under every condition of operation. Test safety controls to demonstrate performance of their required function. Completely test system for compliance with specifications.

3.5 INSTRUCTION TO GOVERNMENT PERSONNEL

Provide [2] [_____] man-days of instruction to [2] [_____] Government personnel in accordance with Section 15050 "Basic Mechanical Materials and Methods" for each type of compressor and compressed air dryer in the project.

TABLE II

HP Piping (2758 kPa (Gage) Higher) Inspection Requirements 1/

Welded Joint type and pipe size, mm	Required Nondestructive Examination					
	VISUAL EXAMINATION		T/PT TEST		RADIOGRAPHY	
	Root Layer	Completed Weld	Root Layer	Completed Weld	Completed Weld	Extent of
Butt 100 and greater	X2/	X	X2/	X3/	X	6.28 radian
Butt 65 to 90 incl	X2/	X	X2/	X3/	X4/5/	At least 105 radian
Butt less than 65	X2/	X	X2/	X3/	X4/5/6/	At least 1.05 radian
All socket and fillets	X2/	X	X2/	X	--	--

Legend: X - Indicates that test is required.

MT Magnetic Particle Inspection
PT Liquid Penetrant Inspection
RT Radiographic Examination

NOTES:

1/ Where new welds in piping intersects existing or older welds, the latter welds shall be inspected for a distance of 150 mm or a distance equal to 50 percent of the pipe size diameter, whichever is less, as measured from points of intersection. The existing or older weld and adjacent base material shall be free from cracks. Where non-intersecting adjacent existing welds are inadvertently radiographed, only cracks shall be cause for rejection.

2/ MT/PT inspect the first or root pass of welds and when accessible, the reverse or back-chipped ground, gouged or machined side prior to depositing metal on the reverse side. Visual examination at 5X magnification may be substituted for MT/PT inspection. Linear discontinuities shall be unacceptable. Use 5X inspection where crevices cannot be cleaned thoroughly.

3/ MT/PT test shall be performed only when post-weld heat treatment is required and when specified on drawing. The test shall be conducted after heat treatment and shall include 6.28 radian of circumferential weld surface and adjacent base material. Where 6.28 radian RT is performed after heat treatment, MT/PT is not required, except where specified on drawing.

Legend: X - Indicates that test is required.

4/ RT of welds on piping in the horizontal fixed position shall represent a sector which was welded in the vertical or overhead position.

5/ In lieu of 1.05 radian RT, PT or MT may be performed on the inside of a joint where weld is within 2 1/2 nominal pipe diameters from the open end is back welded, has backing ring removed or used consumable insert.

6/ RT is required where the working pressure exceeds 3964 kPa (gage). For working pressure 3964 kPa (gage) and below, inspection may be performed in lieu of RT.

-- End of Section --